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Diffusion Controlled Surface Morphology During Solution Growth of KH_2PO_4

T.A. Land, J. Fergurson and J.J. De Yoreo (Lawrence Livermore National Laboratory)

We report the results of "freeze-and-look" atomic force microscopy measurements of KH_2PO_4 {101} surfaces grown from solution. These measurements show that, while at low supersaturation growth proceeds by step-flow on dislocation induced vicinal hillocks, as the supersaturation is increased, there is a transition to layer-by-layer growth on 2D nucleated islands. Furthermore, terraces on vicinal hillocks also exhibit nucleation and growth of islands. Near 300 K, the average island spacing is 50 to 100 nm and there is an island-free region within 100 nm of the step edge. The existence of both of these features demonstrates the importance of surface diffusion during growth from solution. The width of the denuded zones defines a capture range for the steps and provides an estimate of 100 nm for the surface diffusion length near 300 K. Finally, the shapes of the islands show that the free energy of the step edge is isotropic and thus triangular hillock shape commonly observed on KDP {101} surfaces is due to anisotropic diffusion kinetics.

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